BULK SPECIFIC GRAVITY OF COMPACTED BITUMINOUS MIXTURES USING SATURATED SURFACE-DRY SPECIMENS

AASHTO T 166

GLOSSARY

Specific gravity -- the ratio of the mass in air of a volume of material to the mass in air of an equal volume of water.

Saturated surface dry (SSD) -- the condition of a material when it has absorbed as much water as it can and the outside of the material has no free water.

SCOPE

The compaction of HMA in the field and in the laboratory is an important characteristic to be determined for mixture quality control. The bulk specific gravity of compacted specimens (G_{mb}) can be determined on pavement cores or laboratory compacted specimens. The value is used to determine air voids (V_a) and may be used for comparison between roadway compaction tests and laboratory compacted specimens.

The G_{mb} is determined by measuring the volume of the specimen by displacement when submerged in water. The specimen dry weight, weight of the specimen submerged in water, and the SSD weight are determined to calculate the G_{mb}.

SUMMARY OF TEST -- METHOD A

Apparatus

Balance, general purpose class G2 (AASHTO M 231)

Oven

Submersion basket

Water bath, equipped with overflow outlet

Damp towel

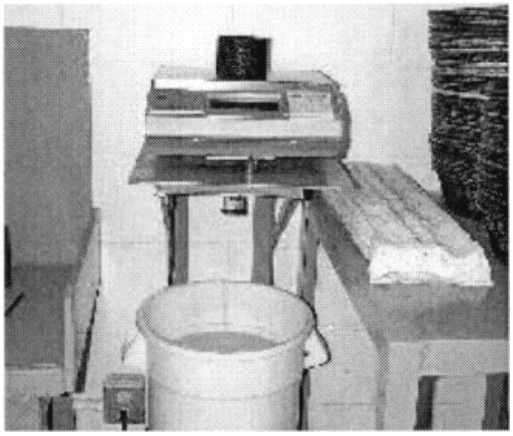
Procedure

1. Dry the specimen overnight at 125 ± 5°F (52 ± 3°C) and weigh at 2-hour intervals until constant weight is achieved. (Not necessary for recently molded specimens)

   Note: Constant weight is defined as the weight at which further drying at 125 ± 5°F (52 ± 3°C) does not alter the weight by more than 0.05 percent.

2. Cool the specimen to room temperature at 77 ± 9°F (25 ± 5°C) weigh, and record weight (A) to the nearest 0.1 g.

3. Immerse the specimen in water at 77 ± 1.8°F (25 ± 1°C) and suspend it from the balance, being careful not to trap any air bubbles under the specimen.



Weighing Specimen

4. Record the submerged weight (C) to the nearest 0.1 g after the specimen has stabilized in the water for 3 to 5 minutes.

5. Remove the specimen from the water and blot with a damp towel as quickly as possible.

   Note: Terry cloth has been found to work well for use as a towel. Damp is considered to be when no water can be wrung from the towel.

Blotting Sample Dry

6. Record the weight (B) of the surface-dry specimen.

Calculations

Calculate the bulk specific gravity of the specimen as follows:

$$Gmb = \frac{A}{B-C}$$

where:

A = dry weight
B = SSD weight
C = submerged weight

Report bulk specific gravity to three decimal places (0.000).

Calculate the percent water absorbed of the specimen as follows:

$$\% \text{ Water Absorbed by Volume} = \frac{B - A}{B - C} \times 100$$

Report water absorption to two decimal places (0.00)

Note: If the percent water absorbed by the specimen exceeds 2 percent, use AASHTO T 275 (Bulk Specific Gravity of Compacted Mixtures Using Paraffin - Coated Specimens)

Example

Given: Dry weight of the specimen (A) = 4799.0 g
SSD weight of the specimen (B) = 4801.0 g
Submerged weight of the specimen (C) = 2799.0 g

$$G_{mb} = \frac{4799.0}{4801.0 - 2799.0} = 2.397$$

$$\% \text{ Water Absorbed} = \frac{4801.0 - 4799.0}{4801.0 - 2799.0} \times 100$$

$$= 0.10\%$$

SUMMARY OF TEST -- METHOD B

Apparatus

Balance, general purpose class G2 (AASHTO M 231)

Water bath, thermostatically controlled so as to maintain the bath at 77 ± 0.9°F (25 ± 0.5°C)

Thermometer, ASTM 17 C having a range of 66 to 80°F (19 to 27°C) graduated in 0.2°F (0.1°C) subdivisions

Volumeter, calibrated to appropriate capacity having a tapered lid with a capillary bore

Procedure

1. Dry specimen to constant weight as indicated in Method A

2. Cool specimen to room temperature at 77 ± 9°F (25 ± 5°C) and record the weight (A) to the nearest 0.1 g

3. Immerse in water bath for at least 10 minutes

4. Fill the calibrated volumeter with distilled water at 77 ± 1.8°F (25 ± 1°C) and weigh (D)

5. Remove the specimen from the water bath, quickly damp dry the saturated specimen by blotting with a damp towel, and as quickly as possible weigh the specimen (B)

6. Place the specimen into the volumeter and let stand for at least 60 seconds

7. Bring the temperature of the water to 77 ± 1.8°F (25 ± 1°C) and cover the volumeter making certain that some water escapes through the capillary bore of the tapered lid.

8. Wipe volumeter dry with a dry absorbent cloth and weigh the volumeter and contents (E)

Calculations

Calculate the bulk specific gravity of the specimen as follows:

$$G_{mb} = \frac{A}{B + D - E}$$

where:

A = dry weight
B = SSD weight
D = volumeter weight filled with water
E = volumeter weight filled with water and specimen

Report bulk specific gravity to three decimal places (0.000)

Calculate the percent water absorbed of the specimen as follows:

$$\% \text{ Water Absorbed by Volume} = \frac{B - A}{B + D - E} \text{ x } 100$$

Note: If the percent water absorbed by the specimen exceeds 2 percent use AASHTO T 275.

SUMMARY OF TEST -- METHOD C (RAPID TEST)

This procedure can be used for testing specimens which are not required to be saved and which contain substantial amounts of moisture. The testing procedure is the same as used in Method A and B except for the sequence of operations. The dry weight (A) of the specimen is determined last as follows:

1. Place specimen in a large flat bottom drying pan of known weight.

2. Place pan and specimen in a 230 ± 9°F (110 ± 5°C) oven until the specimen can be easily separated to the point where the particles of the fine aggregate binder portion are not larger than 1/4 in. (6.4 mm).

3. Place separated specimen in 230°F (110°C) oven and dry to a constant weight.

   Note: Constant weight is defined as the weight at which further drying at 230 ± 9°F (110 ± 5°C) does not alter the weight by more than 0.05 percent.

4. Cool pan and specimen to room temperature at 77 ± 9°F (25 ± 5°C) and weigh. Dry weight of specimen is determined by subtracting the weight of pan from the weight of pan and sample.

Calculations

Calculate the bulk specific gravity of the specimen using the same procedure as required in Method A and B.